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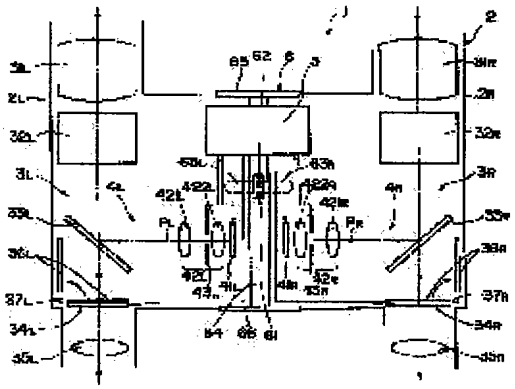
(54) BINOCULAR

(57)Abstract:
PURPOSE: To provide binoculars which enables one selectively view with both eyes the optical image of an object and the photographed image by an image pickup element.
CONSTITUTION: An electronic binocular camera 1 has finder optical systems 3R, 3L, image display means (LCD) 34R, 34L, image pickup elements (CCD) 41R, 41L, photographing optical systems 4R, 4L for imaging thereto, and back lights 36R, 36L capable of being rotated and lighted/extinguishing in a body 2 consisting of right and left housings 2R, 2L. When the image display means 34R, 34L are in non-operated state, they are transparent, and the back lights 36R, 36L are moved to the retreat position and extinguished, so that the optical image of a subject can be viewed with both eyes through the finder optical systems 3R, 3L. When the photographed images by the image pickup elements 41R, 41L are reproduced by the image display means 34R, 34L, the back lights 36R, 36L are bonded to the back surface of each image display means and lighted, and the reproduced images can be stereoscopically observed by both eyes.



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[0018]

[Preferred example embodiments]

A binoculars of the present invention will be detailed below according to preferred example embodiments shown in accompanying diagrams.

[0019]

Fig. 1 is a cross-sectioned plane diagram schematically showing an example when a binoculars of the present invention is applied to an electronic camera loaded with record/playback function of the shot images.

[0020]

As shown in Fig. 1, electronic camera binoculars 1 of the present invention has main body 2 consisting of right housing barrel 2R, and left housing barrel 2L. Right and left housing barrels 2R and 2L are configured such that they get close and apart by moving in parallel relative to each other by way of barrel alignment means 6.

[0021]

Inside right housing barrel 2R of main body 2, there is provided finder optical system for a right eye (right eye second optical system) 3R in order to watch a subject (object) with the right eye, and inside left housing barrel 2L thereof, there is provided finder optical system for a left eye (left eye second optical system) 3L. These both finder systems 3R and 3L can make a right-eye image of the subject and a left-eye image thereof stereoscopic.

[0022]

Also, inside right housing barrel 2R, there are provided image pick-up element for a right eye 41R, and shooting optical system for a right eye (right eye first optical system) 4R forming the right-eye image on image pick-up element for a right eye 41R, and inside left housing barrel 2L, there are provided image pick-up element for a left eye 41L, and shooting optical system for a left eye (left eye first optical system) 4L forming

the left-eye image on image pick-up element for a left eye 41L.

[0023]

Electronic binoculars camera 1 shown in the diagram is almost symmetrically structured, so explanations will be given below only with respect to the right eye as a representative.

[0024]

Finder optical system 3R includes objective lens 31R, erecting optical system 32R, half mirror 33R, image displaying means 34R, and eyepiece lens 35R, and they are arranged in order from an incident side (upper side in the diagram) of the light from the subject.

[0025]

Shooting optical system 4R includes objective lens 31R, erecting optical system 32R, half mirror 33R, reduction optical system 42Rm and aperture diaphragm 43R, and objective lens 31R, erecting optical system 32R, and half mirror 33R are used in common with finder optical system 3R.

[0026]

Objective lens 31R is arranged so as to be movable in a direction of the optical axis by way of a focusing device (not shown in the diagram), and is configured so as to enable the subject image to be formed on an image displaying plane of image displaying means 34R to be described later. Moreover, objective lens 31R may be configured such that its magnification is variable with a zooming mechanism, which is not shown here. Furthermore, focusing and zooming operated by moving the objective lens are implemented jointly with both objective lenses 31R and 31L.

[0027]

As erecting optical system 32R, for example, a polo prism, daha prism, and schmidt prism are used in the erecting optical system. With this erecting optical system, an erecting erect image of the subject can be viewed via the eyepiece lens.

[0028]

Eyepiece lens 35R is to magnify the subject image formed on the image displaying plane of image displaying means 43R, and

a playback image by way of image displaying means 34R to a desired magnification, and is provided with a dioptre adjustment mechanism, which is not shown here.

[0029]

The flux of light subsequently passing through objective lens 31R and erecting optical system 32R is split into two different directions, that is, one bound for image displaying means 34R and other bound for image pick-up element 41R.

[0030]

In between half mirror 33R and image pick-up element 41R, there are placed reduction optical system 42R, and diaphragm 43R. Reduction optical system 42R includes condenser lens 421R, and image forming lens 422R, and diaphragm 43 placed in between the foregoing lenses.

[0031]

After the flux of light reflected by half mirror 33R is temporarily formed at image forming position PR in front of condenser lens 421R, the flux of light enters into condenser lens 421R, and is relayed by condenser lens 421R and image forming lens 422R to once again form the image on a photo-sensing plane of image displaying means 34R.

[0032]

On the other hand, the flux of light passing through half mirror 33R through objective lens 31R and erecting optical system 32R forms the erecting erect image on the image displaying plane of image displaying means34R.

[0033]

That is, a plane including image forming position PR and perpendicular to the optical axis, and the image displaying plane of image displaying means 34R are optically in conjugate relationship with each other.

[0034]

A reduction magnification of reduction optical system 42R is adjusted in such a manner that an optical image formed on the image displaying plane of image displaying means 34R coincides with the corresponding playback image by way of image

displaying means 43R (the same magnification).

[0035]

Moreover, diaphragm 43R is actuated by diaphragm driver circuit 10 to be later described, and in order to make brightness of each playback image by way of the image displaying means 34R and 34L almost equal, two diaphragms 43R and 43L are actuated together in such a manner that these diaphragm values and depth-of-fields become identical.

[0036]

With the foregoing, the subject image formed on the photo-sensing plane of image pick-up element 41R is converted into an image signal, and after it undergoes given processing by signal processing circuit 5 mounted inside main body 2, which is later described, it is played back by image displaying means 34R. The image signal processed by signal processing circuit 5 is recorded in a recording medium in accordance with a given format.

[0037]

In the present example embodiment, a flat-panel liquid crystal display (thereafter referred to LCD) is used as image displaying means 34R. This LCD includes a display picture element group (image displaying plane) arranged in a matrix, and the LCD appears almost transparent when it is off duty (a state where voltage is not applied to each picture element), and the image shot by image pick-up element 41R is played back in color or black and white with the give voltage applied to each display picture element by actuating LCD drive circuit 16R, which will be later described. Upon playback of the image by LCD, the image is illuminated from a rear side by back light 36R, which will be later described.

[0038]

Moreover, image pick-up element 41R is what the picture element group having functions of a photo-electrical conversion and an electrical-charge accumulation, and a scanning circuit sequentially reading the image signal accumulated in each picture element are integrated on the same substrate, and in

this example embodiment, CCD (charge coupled device) is used. In this case, an effective photo-sensing picture element and effective display picture element of LCD correspond to each other one by one.

[0039]

Back light 36R is made up of a surface light source like, for example, a cathode unidirectional light-emitting fluorescent lamp, and is placed such that it can be rotated around supporting point 37R, and is configured in such a manner that a not-shown here back light actuation mechanism permits the back light to move to a position where the back light is in contact with a rear plane of display imaging means 34R, and a retracting position away from the optical axis of finder optical system 3R. This movement is implemented jointly with both back lights 36R and 36L.

[0040]

On a rear surface of back light 36R, there is formed, for example, a black tint light-tight plane, and when back light 36R is in contact with the rear surface of image display means 34R, light transmitting through half mirror 33R is shaded. With this, upon playback of the shot image by image displaying means 34R (at a second state), the optical image through finder optical system 3R is projected onto the image displaying plane of image displaying means 34R, thereby preventing this optical image from being superimposed on the playback image. Moreover, when observing the optical image of the subject with finder optical system 3R (at a first state), back light 36R is turned off, and moves to the retracting position, thereby preventing observation of the optical image from being disturbed.

[0041]

With such back light 36R and the back light actuation mechanism, a superimposed-image prevention means is configured that prevents the optical image of the subject from appearing superimposed on the playback image upon playback of the shot image.

[0042]

Such respective configurations for a right eye are also the same as corresponding respective configurations for a left eye (objective lens 31L, erecting optical system 32L, half mirror33L, image displaying means 34L and eyepiece lens 35L, supporting point 37L, back light 36L and its actuation mechanism, image pick-up element 41L, reduction optical system 42L (condenser lens 421L, image forming plane 422L, and image forming position PL)).

[0043]

Such electronic binoculars camera 1 is provided with a switching means to switch over between the first state capable of making the optical image of the subject stereoscopic via eyepiece lenses 35R and 35L by finder optical systems 3R and 3L, and the second state capable of making respective playback images shot by image pick-up elements 41R and 41L by way of image displaying means 34R and 34L stereoscopic via eyepiece lenses 35R and 35L.

[0044]

In the present example embodiment, this switching means is configured mainly by a not-shown here mode selector switch, release switch and the superimposed image prevention means.

[0045]

In the first state, image displaying means 34R and 34L become off duty, and as the light is transmittable, the light from the subject is formed on the image displaying plane of image displaying means 34R and 34L as the optical image sequentially passing through objective lenses 31R and 31L, erecting optical systems 32R and 32L, and half mirrors 33R and 33L, respectively, and this optical image can be watched stereoscopically by both eyes via eyepiece lenses 35R and 35L, respectively. Furthermore, in the first state, for example, a frame composition upon shooting can be determined. When the optical image of the subject is viewed through finder optical systems 3R and 3L as described in the foregoing, the frame composition can be executed without actuating signal processing circuit 5 at all times, so that there is advantages in that power can be

saved, and the eyes are less worn even with a long-hour peeping into the finder.

[0046]

On the other hand, in the second state, the image signal about the shot image to be played back is read out from the recording medium, and undergoes the conversion and processing as desired, and is played back and displayed on respective image displaying planes of image displaying means 34R and 34L, and back lights 36R and 36L move to the rear surfaces of image displaying means 34R and 34L, respectively, and are lit to illuminate image displaying means 34R and 34L. Then, these playback images can be watched stereoscopically by both eyes via eyepiece lenses 35R and 35L, respectively.

[0046]

With such electronic binoculars camera 1, given conditions about the optical image of the subject stereoscopically viewed in the first state, and the playback image stereoscopically viewed in the second state,, that is, there is provided an adjustment means such that there is no reversion of the playback image with respect to the optical image, and the optical image and the playback image by way of the image displaying means can be observed at the same magnification. The adjustment means of the present example embodiment is to make an adjustment combining an electronic adjustment about the former, and an optical adjustment about the latter, and includes mainly control circuit 17 incorporating an address control circuit, which will be later described, and reduction optical systems 42R and 42L.

[0048]

The reversion adjustment of the playback image is not limited to the electronic adjustment, but it may be configured such that the image is caused to be reversed again by causing the mirror, or a prism having a reflective surface, for example, to lie in between half mirrors 33R and 33L and image pick-up elements 41R and 41L.

[0049]

A distance between both finder optical systems 3R and 3L is adjustable by barrel alignment means 6.

[0050]

This barrel alignment means 6 is provided in between right housing barrel 2R and left housing barrel 2L as shown in Fig. 1, wherein it includes adjustment screw 61 consisting of knob 62, and a pair of screw members 63R and 63L engaging with each housing barrels 2R and 2L protruding in an opposite direction of each other from knob 62, and base shaft 64 holding adjustment screw 61 such that screw 61 can be rotated, and a pair of movement rails 65 and 66 arranged in front of and behind main body 2, respectively, for guiding movement of both housing barrels 2R and 2L. Both screw members 63R and 63L of adjustment screw 61 have their screws reversely formed, respectively.

[0051]

When adjustment screw 61 is rotated by operating knob 62, both housing barrels 2R and 2L are moved along movement rails 65 and 66 in parallel, and both housing barrels 2R and 2L get close or apart corresponding to a rotating direction of adjustment screw 61,. With this, the distance between finder optical systems 3R and 3L, that is, the distance between both housing barrels can be adjusted.

[0052]

As barrel adjustment means 6 of such the configuration adjusts the distance between the housing barrels by moving finder optical systems 3R and 3L in parallel, there is no inconvenience in that the shot images played back on image displaying means 34R and 34L are rotated.